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Mendelism and Sheep Breeding

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IN the very earliest days of animal breeding, there was only one thought uppermost in the breeder's mind: to increase the numbers in his herd or flock. In the due course of time, however, it became apparent to the observing breeder that it was not wise or provident to breed only for numbers. Newer types and better adapted animals were desired. The progressive breeder always kept his mind open and alert to learn any new devices by which he could accomplish this end. Such methods or systems of breeding as line breeding, inbreeding, grading, and above all, rigid selection, were devised and practiced to meet particular or special ends. They were, and still are, the time-honored methods in the art of breeding. New methods and new systems will arise in the future, just as they did in the past, and they will likewise be accepted or rejected by the breeder according to their merits.

We have frequently heard of Mendel's Law of Heredity in the last few years, and it is only natural that breeders should inquire as to its essence and application to their problems. As is generally true with all new ideas, much confusion and wild speculation has been attached to this subject. At the outset, it may be well to state that Mendel's Law is, in no sense, a system of breeding, but rather a scientific explanation of the transmission of characters from parents to offspring in any system of breeding. One of the most essential attributes to clear thinking on the subject of breeding is to distinguish carefully between a system of breeding and an explanation for the results of any given system. From time immemorial, we have been regaled with one explanation after the other; and it is perfectly safe to say that most of them, when critically analyzed, were found to be of little or no value. The primary prerequisite of any explanation for results seen in breeding is that it shall show how, when, and why characters are transmitted from parents to offspring. The most recent and withal the most successful theory to account for the transmission of parental characters is Mendel's Law of Heredity. Whenever new discoveries, such as Mendel's discovery, are made, the breeder inquires quite legitimately "Has it any immediate bearing on my plans and problems in breeding on the farm or range?" Erroneous impressions are like weeds, easily produced and widely spread. This is particularly true when scientific abstractions are involved as is the case with Mendel's Law. It is not at all uncommon to find extravagant promises rashly made that Mendelism will solve all of our breeding problems. In fact, much discredit has been already attached to Mendel's Law by those who confuse it with systems of breeding, and attempt to use it without sufficient knowledge of the many scientific complexities and ramifications involved. There are, to be sure, many dangers of misleading the sheep breeder when one attempts to explain Mendelism in simple terms, primarily because the operation of Mendel's Law is based upon biological and mathematical facts more complex than simple terms will explain. I am therefore well aware that I am in danger of confusing the breeder and laying myself open to criticism, when I try to point out any relationship between Mendelism and some sheep-breeding problems, for, I must keep my thesis in simple terms and avoid the technicalities of the classroom. With these precautions in mind, let us inquire what bearing Mendel's Law has to sheep breeding.

Gregor Mendel, the Augustinian monk, prelate of the monastary at Brunn, Austria, worked on the problem of hybridization using chiefly the edible or garden-pea. About 1865, he published two brief papers in the journal of the local scientific society stating the results of eight years' work. His work was not well received, in fact was neglected and all but forgotten. The facts of the case are that Mendel was years ahead of his time and not until years after his death did the truth dawn upon the scientific world at large. In 1900 his work was rediscovered and corroborated. Mendel showed that an individual plant or animal is a sum total of separate independent characters, some large, others small, some quite apparent and others quite hidden. When these characters are transmitted they are transmitted as units or as a whole, and they may be recombined with one another in such ratios as we expect according to certain mathematical expectations.

To be concrete, let us illustrate how Mendel's Law works by crossing a pure white guinea-pig male with a pure black female such as is shown in figs. 1 and 2. Here we are dealing with a simple pair of characters, and if we follow this simple pair without regard to any other differences whatsoever, we shall find that all crossbred children will be black, as shown in fig. 3. We say then that blackness in guinea-pigs is dominant to whiteness, and we call the white or albino variety recessive because it recedes from our view in the crossbreds. Now although all these crossbred children are black in appearance, they obtained black from only one parent, while they

obtained the hidden or recessive white condition from the other. In other words, they are dual in nature, having obtained the visible black from one parent and the hidden white from the other. We can easily prove this by mating black crossbred children together to produce grandchildren, and we find that the crossbreds do not breed true but give among the grandchildren blacks and whites again. Furthermore, these black grandchildren occur three times as frequently as the white ones in the long run. Mendel made clear to us why this result takes place. The white grandsire produces sperm all of which carry something (we shall not state what) to produce whiteness, while the pure black granddam produces eggs carrying a substance giving the black color. Any of his sperm might fertilize any of her eggs, but the crossbred children so produced carry both the blackness and whiteness, although they are black in appearance because the black color covers over the white or is dominant to it. These crossbred children are, of course both males and females and, as we said, dual in nature. Being dual in nature, the males now produce sperm half of which carry black and half of which carry white; and the females produce eggs in similar manner. In other words, black and white separate from each other when the germ cells are formed, so that a germ cell contains either one or the other of this pair of characters but never both. Such being the case, we can now see why we obtain among the grandchildren a ratio of 3 black to 1 white in the long run. It is simply because when the crossbred children are mated together the combination of germ cells which come together in fertilization to produce the grandchildren can only be as follows:

1. Sperm carrying black can fertilize eggs carrying black and give pure black young.

2. Sperm carrying black can fertilize eggs carrying white and give crossbred black young because black is dominant.

3. Sperm carrying white can fertilize eggs carrying black and give crossbred black young because black is dominant.

4. Sperm carrying white can fertilize eggs carrying white and give pure white young, no black being present. We see that there are three times as many combinations giving black as white, hence our ratio. Furthermore, it will be noted that in the first combination the black is derived from both parents, but in the second and third combinations black is derived from one parents and white from the other. Thus it happens that one-third of the black grandchildren are pure for black and breed true, while two-thirds are crossbred for black and breed as the crossbred children did. Extensive breeding experiments have proven this completely, for we could never tell from external appearance whether the grandchildren are pure for black or not, since black is dominant.

It will be noted that the white male in fig. 1 has a rough coat with swirls, but the dam in fig. 2 has a smooth coat. If we follow roughness and smoothness in a cross just as we did black and white, we find that the crossbred children are rough-coated as is shown in fig 3, because roughness is dominant to smoothness. Breeding the crossbred children together will give three times as many rough grandchildren as smooth ones in the long run. The reason is obviously the same as that given for the black-white cross.

The case becomes more complex if we attempt to follow black, white, roughness, and smoothness simultaneously in a cross. If we cross a pure white, rough male (fig. 1) to a pure black, smooth female (fig. 2), the rough character and black character are dominant as we might expect from the previous illustrations, and so the crossbreds are black, rough individuals (fig. 3). If we now breed the crossbred children together, we shall obtain in the long run the following classes:

9 Black Rough (fig. 4).
3 Black Smooth (fig. 5)
3 White Rough (fig. 6)
1 White Smooth (fig. 7)

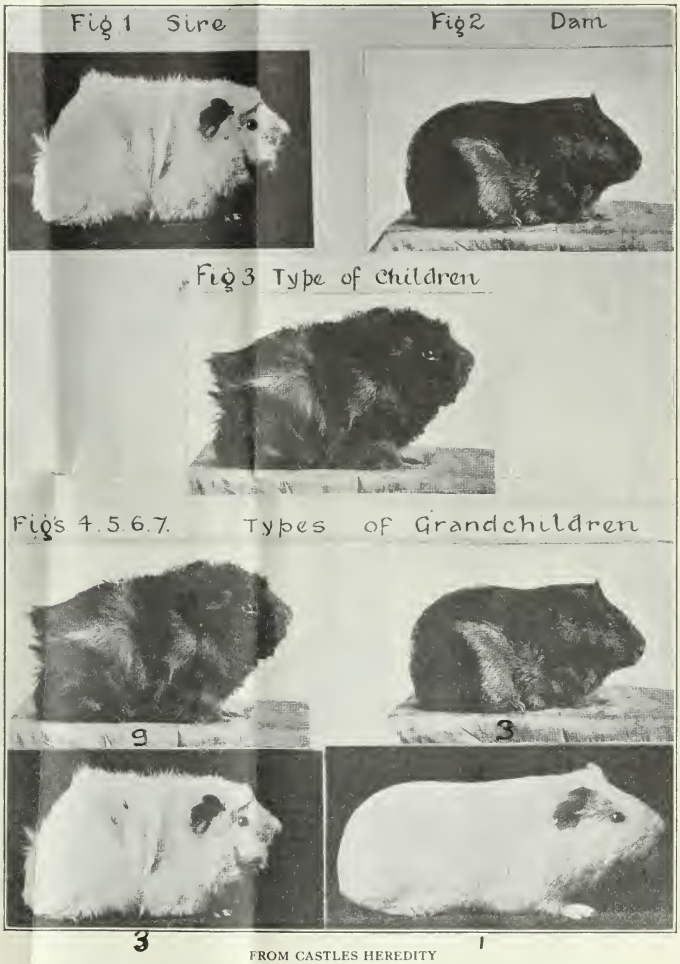
This "splitting up" or segregation and recombination of characters in the hybrids is the essence of Mendelism. It will be noted that we began with a rough, white male and a smooth, black female, and now we have in the grandchildren two new combinations, black-rough and white-smooth. In general, we may say that the greater the number of differences in the parents, the greater the variability in the progeny. Let us suppose, for the sake of illustration alone, that the breeder wished such a combination of characters as the black-rough combination. How would he get it to breed true? We saw that when the crossbred black, rough children were bred together, they gave new forms or variations. We should also find that, among the grandchildren, not all black-rough individuals are equally pure in breeding. Some would be pure for either blackness or roughness, but very few for both. We could find by experimental breeding which individuals are pure for both blackness and roughness and thus start a pure breeding race of black-rough guinea-pigs immediately. There is another method by which we could get a pure black-rough-coated race. We could mate individuals of the desired type together and keep eliminating the culls, as well as those individuals which produce the largest number of culls. Eventually we should establish a pure race of black-rough individuals.

In our domestic animals there is no real fundamental difference in the transmission of characters from that of our illustration, except that we deal with very many characters, most of which are too complex and subtle for such simple elementary analysis. For those who desire a more detailed consideration of Mendelism, such books are to be recommended as Professor James Wilson's "Principles of Breeding" (published by Vinton & Co.) or that excellent little book by Professor Castle called "Heredity" (published by D. Appleton & Co.).

Enough has been given in our illustration of the working of Mendel's law to show what we must expect in some

of our sheep breeding problems. Some breeders are trying to combine such complex characters as density fineness and weight of fleece, hardiness, the flocking instinct, and the like from the Merino blood, with length of wool, mutton conformation and the like from the Lincoln, Leicester, Oxford, Romney Marsh, or similar blood. This is really an experiment in hybridization, very much like the rough-white guinea-pig crossed to the smooth black, and the analogy is instructive to say the least. The breeder sometimes obtains a very desirable type by crossing these two widely different varieties of sheep, particularly if he uses pure-bred stock to begin with. Then, having obtained a desirable cross, he wishes to hold the type secured. Here is where the disappointments are bound to arise. One hears breeders say they would give much if they could hold the remarkable blend of characters which they have obtained in a cross. The cross, however, is like any cross in which the parents differ in many respects, and the progeny are bound to show increased variability because so many characters combine and recombine in all the various possibilities. In other words, when a breeder crosses a Merino type with a mutton type, to secure the good characters of both, he must expect to get much variability in subsequent generations. It is the same case as the white-rough guinea-pig crossed to the black-smooth one, only our sheep cross is more complex and deals with a larger number of characters. The desirable blend can only be held at the expense of much selection and culling. The undesirable types should be eliminated, and the desirable combinations continually bred together. Eventually we may hope to fix, hold, and breed pure the combination of Merino and mutton qualities which we seek in such a cross, but it takes much effort, time, and selection. Cross breeding induces variability and Mendel showed us the reason for this by showing how characters are rearranged in the offspring in all sorts of possible combinations. Any combination obtained is not necessarily pure, for it may have dominant characters covering up the hidden or recessive ones. To purify the type, inbreeding and selection are necessary, and the risk of rejecting many culls must be faced.

Such has been the experience of breeders when any new type has been founded by crossing. The writer was much interested in the history and method of building up the Corriedale breed of sheep. This new breed represents the efforts of crossing Merinos with some mutton type such as Lincoln rams. The expected happened, for this wide cross gave much variation in early years and required much culling. To my mind, the variation was due to the recombination of those many characters, in which the original parent stocks differed. The culling represents the elimination of the undesirable combinations. The desirable combination has been purified, at the expense of rigid selection. If any attempt is to be made in our country to



FROM CASTLES HEREDITY

produce a type which shall combine Merino and mutton qualities, we must keep our minds open to certain probabilities. The crossbred combination will break up into many forms, but only the best should be used for breeding. Culls or undesirable combinations are bound to appear and must be rejected for breeding purposes even though their number is large.

PANAMAS FOR RAM SALE.

Regarding the Panamas that we are sending to the Salt Lake ram sale, I would say that the Panamas are not like the man who tells you he is honest; as a rule after you have dealings with him, you begin to doubt it. A range sheepman that ever gets to see a Panama will know that for producing wool and mutton under range conditions you cannot beat him. Therefore, I will not try to further describe the Panamas, but will depend upon the sheepmen knowing a good thing when they see them at the Salt Lake ram sale.

JAMES LAIDLAW,
Muldoon, Idaho.

TRADE CONDITIONS IN MONTANA

"There will be few fat sheep to come out of Montana this year," said J. V. Merrian, who has been in that quarter buying wool. "The local market is on a minature boom. Everywhere the buyers are as thick as the proverbial hair on a dog. Iowa and Wisconsin orders for feeding lambs are much in evidence, and thousands have been contracted. The Reas have secured thousands at 6¼ cents per cwt.. and the Wilsons of Burlington, Wisconsin, have acquired 20,000. Iowa buyers are encountered by the dozens, and they are not speculating by any means, their pockets being full of orders. There is a big trade in stock sheep and ewes at prices that look prohibitive, but present figures on wool have injected confidence, and bankers are handing out the money to those in a position to handle sheep without much haggling.

"The advance in wool means that the flockowner has good credit as he is getting the full benefit of the upturn. The Montana clip will be 10 to 15 per cent lighter than last year and is fully 50 per cent less than a few seasons back when the state was full of sheep before liquidation began.

"To what extent the industry will be rehabilitated under new conditions can only be conjectured, but the limit is visible. The day when big bands of sheep could be run in Montana has passed owing to the manner in which the range has been cut up. There is a disposition to run wethers again, however, creating a broad demand for yearlings and aged stock. For yearling and two-year-old wethers $3.25@ $3.50 per head are the ruling prices and values are going up. As a rule settlers are not going into sheep or any other kind of livestock, in fact most of them are doing well to be able to stay on the ground and prove up their claims.

"Demand for lambs bred in the mountains is keen and even the flat country stuff, which weighs 40@50 pounds is being bought. The run will be late as grass is abundant, and few Montana lambs are likely to go east before October. Most of the ewe lambs will be held back and any kind of an old ewe is eligible to a bid as pulp feeders are apprehensive that they will not be able to fill up next fall. Everything that looks like a breeding ewe will be carried over.

"Fat wethers are held at $5.75@ 6.00, and old ewes for pulp feeding at $3.00 per head. Little yearling ewes for breeding purposes are on a $5.00@5.50 basis and it promises to be a $6.00 market on a per head basis for breeding ewes next fall. Demand for this stock is growing keen, and there will not be enough to go around.

"The rise in wool is responsible for an opinion that wethers can be run profitably and they are held at $4.00 @4.50 per head. The entire situation is bullish. Just how cornbelt operators are going to fill their feed lots in the fall is a problem."

BOYS FEEDING CONTEST FOR THE 1915 INTERNATIONAL LIVE STOCK EXPOSITION.

With a view to developing a school of successful feeders of cattle, sheep and swine, from the ranks of the youthful members of our farm homes and firesides, whose achievements may in time surpass the best traditions of their ancestors as meat producers, the Union Stock Yard & Transit Company will offer the following prizes on animals fed by boys sixteen years old and under:

Best steer or heifer under 30 months

1st prize	$50.00
2nd prize	40.00
3rd prize	30.00
4th prize	20.00
5th prize	10.00

Best pen of 5 lambs of any of the mutton breeds:

1st prize	$50.00
2nd prize	40.00
3rd prize	30.00
4th prize	20.00
5th prize	10.00

Best pen of 5 barrows under 12 months.

1st prize	$50.00
2nd prize	40.00
3rd prize	30.00
4th prize	20.00
5th prize	10.00

Conditions.

All entries to be made in the name and by the feeder. Exhibitors will be required to personally care for their animals without the aid of an assistant.

Feeding term from August 1st to opening of the International.

Notice of intention to enter one or more of these feeding contests to be mailed to B. H. Heide, secretary Union Stock Yards, Chicago, at the beginning of the feeding period, who will upon receipt of notification mail you formal entry blanks. No entrance fees will be charged in above classes.

Please look at the advertisements of sheep and rams for sale in this issue.